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DESCRIBES OPERATION OF LIQUID-FUEL ROCKET ENGINES

A reader asks: How do airplanes with liquid-fuel rocket engines fly in the atmosphere and in airless space? What is the application of these engines in aviation?

A liquid-fuel rocket engine like other types of reaction engines, increases its power with an increase in speed. This is the basic differentiation from reciprocating engines. A liquid-fuel rocket engine can operate in a vacuum. It has its own supply of an oxidizing agent.

Fuel and the oxidizing agent are fed from tanks to the combustion chamber in fixed proportions. The most widespread fuel and oxidizing mixture used in modern liquid-fuel rocket engines is kerosene, nitric acid, ethyl alcohol, and liquid oxygen. The selection of the fuel and oxidizing agent is a very complicated problem. It depends not only on the combustion system of the engine, but also on the aerodynamic data of the airplane.

The fuel and oxidizing agent are dispersed in the combustion chamber by nozzles and are converted into a combustible mixture. In burning, the mixture forms gases, which, under a pressure of 20 to 40 atmospheres, are released outward through a nozzle. The temperature in the combustion chamber is raised more than 2,000 degrees. Due to the great difference in pressure and the high temperature, the speed of the gases expelled from the nozzle reaches 2,500 meters per second. The speed of the gases would be 4,000 meters per second at 100 percent efficiency. It would be most efficient to fly at the speed equal to the speed of the gases expelled from the jet -- 2,500 meters per second. However, this speed has not yet been attained in aviation. Therefore, the efficiency of a liquid-fuel aviation rocket engine is very low.

Fighters can fly at a speed of 1,000 kilometers per hour with liquid-fuel rocket engines. But the duration of their powered flight is only about 10 minutes. By turning on the engine intermittently, such a plane can remain in the air 25 to 30 minutes.

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Liquid-fuel rocket engines can be used to accelerate modern fighters powered by reciprocating engines. Operating about 3 minutes, such an auxiliary rocket engine increases the speed of a plane by 100 to 120 kilometers per hour.

A liquid-fuel rocket engine, installed on a propeller-driven airplane, shortens the take-off by 50 to 66 percent, and also aids heavily loaded airplanes in taking off. After take-off, the auxiliary engines are dropped by parachute.

Liquid-fuel engines are also used in long-range rockets and meteorological rockets.

The importence of liquid-fuel rocket engines for aviation is apparent. But jet engines are mainly used in aviation at present because of the number of inconveniences which restrict the application of liquid-fuel rocket engines; in particular, the large supplies of an oxidizing agent needed. Liquid-fuel rocket engines have enormous significance in solving problems of rocket flights above the atmosphere.

The further development of liquid-fuel rocket engines, and in particular the application of atomic energy to the reaction engine principle, will permit attaining flight speeds sufficient to overcome the force of gravity. --
M. Nazmov

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